ACADEMIC PORTFOLIO

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## FT101: INTRODUCTION TO FINTECH

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# CHAPTER ONE

## INTRODUCTION

A lot of studies and literature have been done on stylized facts and the use of different models in testing for these empirical properties of asset returns. This study seeks to add to the body of knowledge by testing for heavy tails, volatility clustering and absence of autocorrelation in shares of different industries using python code on jupyter notebook. This is done to investigate the consistency of empirical properties of financial returns across industries. These industries include manufacturing(Mercedes Benz), financial(Goldman Sach), technology(Apple) and retail(Walmart).

### RESEARCH PROBLEM

This study seeks to answer the following questions using theoretical and empirical proofs:

a. Background: What are the stylised facts of asset returns?

b. Research questions:

* + 1. How do asset returns behave?
    2. What role does financial technology play in ascertaining asset behaviour?
    3. What is the implication of asset returns behaviour and financial technology for asset management?

### CHAPTER OUTLINE

Chapter one covers the introduction

Chapter two is the literature review

Chapter three covers empirical and theoretical review

Chapter four deals with the conclusion

# CHAPTER TWO

## LITERATURE REVIEW

## DEFINITION OF CONCEPTS

#### STYLIZED FACTS

What are stylized facts? Tinbergen (1959) first defined stylization as the grouping of facts in such a way that it doesn't lose it’s properties. Hierchman in his article stylized facts in social science defined it as a group of reoccurring observations in the search for a causal explanation. The stylized fact was coined by Nicholas Kaldor in his argument on theories of economic growth in the year 1961 and he called it a “Stylized view of facts” (Buchanan, 2012). What is Stylized fact of asset returns? According to Rama, it’s a set of properties, common across many markets, instruments, and time periods, that have been observed by independent studies. Pagan (1996) defines it as characteristics of financial series. There are 11 well-known stylized facts which were highlighted and explained by R.Cont. It can be said from these various definitions that stylized facts are empirical findings that have been observed over time and have been found consistent in findings.

Table 1

|  |  |
| --- | --- |
| STYLIZED FACTS | DESCRIPTION |
| Absence of Autocorrelation | In a linear measure of returns, the past data does not affect the data of the present or predict future data. In other words, there is no relationship between the past data and future data, and this is called absence of autocorrelation(linear). That is exempting small intraday time scales |
| Heavy Tails(fat tail) | This is when a return distribution has extreme values. Characteristics of a heavy tail include skewness and excess kurtosis. A normal distribution is expected to have a kurtosis of 3.0 and 3 standard deviations from the mean. If the kurtosis is higher than 3.0 then the distribution has a heavy tail. |
| Aggregational Guassianity | When time increases(change in time) the distribution becomes more normal or in other words as time changes, the normality of distribution increases. |
| Gain/Loss Asymmetry | The drawdown or fall in the price of a stock or financial asset is not the same as the increase(upward movement) in the price of the same magnitude. |
| Intermittency | This is an irregular burst of volatility. This is when a return displays a high variability in any time scale. |
| Volatility Clustering | According to R Cont, study of measures of volatility has shown that there exists autocorrelation in volatility. That is, a high volatility event is followed by another volatility, which is a clustering of volatilities before it becomes normal. |
| Leverage Effect | There exist a relationship between price and returns. There is a negative correlation between volatility and the returns of an asset. |
| Unconditional Heavy Tails | After correcting a distribution of returns, there exist heavy tails, this is called unconditional heavy tails. These are heavy tails that exist in a conditional distribution of returns, though these heavy tails are not as heavy in an unconditional return distribution |
| Volume/Volatility Correlation | Volume and volatility have a positive correlation or relationship. |
| Slow Decay of Autocorrelation in Absolute Returns | Autocorrelation exists in absolute returns as a function of time lag. Autocorrelation decays slowly in absolute returns with respect to time. |
| Asymmetry in Time Scales | Finer measure of volatility is predicted better by coarse measure of volatility than finer measure of volatility predict coarse measure of volatility. |

Stylized facts can be further classified into two groups or classes based on the properties they exhibit in terms of asset returns, they are: distribution and dependant classes. Some of the stylized facts also seem to indicate a correlation with each other from the theoretical point of view.

##### DISTRIBUTION PROPERTIES OF RETURNS

These are stylized facts that have distribution properties that answer the questions of normality and non-normality of returns distribution, they include Heavy tails, Conditional heavy tails and Aggregational guassianity. Dependent

##### DEPENDENT PROPERTIES OF RETURNS

This class exhibit dependency characteristics, they include Absence of Autocorrelation, Volatility Clustering, Slow Decay of Autocorrelation in Absolute Returns, Volume/Volatility Correlation, Leverage Effect, Intermittency, Gain/Loss Asymmetry, and Asymmetry in Time Scales.

#### ASSET MANAGEMENT

Lloyds bank defined asset management as the daily running of wealth portfolios, which involves assessing risk, finding opportunities and developing overreaching strategies for reaching financial goals. I It as a practice of increasing the total amount of wealth in time by acquiring, maintaining and trading investments that have value growth potential. According to Forbes, it is rendering a service of money management to clients, by identifying the financial goal of the client and working to meet these goals through portfolio management. It is a process of developing, operating and maintaining assets In a cost-effective manner, according to CFI. It can then be defined as a process of acquiring, maintaining, improving and disposing of assets, taking considerating risk and cost. Assets can be classified into two groups, fixed(noncurrent) and current assets. Examples of these assets are equities, bonds, shares, real estate, funds, commodities, managed futures. Asset management types can vaguely be classified into three types:

##### PHYSICAL ASSET MANAGEMENT

This involves the management of fixed assets such as inventory and infrastructure.

##### FINANCIAL ASSET MANAGEMENT

This is the management of current assets, which include bonds, stocks and other financial assets.

##### CONTRATUAL ASSET MANAGEMENT

The management of non-material assets, such as digital and intangible assets.

Important terms such as return on asset (ROA) and risk management need to be defined when discussing the concept of asset management.

RISK MANAGEMENT- According to IBM, it is a process of identifying, assessing and controlling legal, financial, security and strategic risks or threats to an organization’s earnings and capital. CFI defines as the identification, analysis and response to the factors of risk that form part of a business. There are standards or set of rules which dictate risk management practices, such as ISO 31 000 standards.

RETURN ON ASSET- This is profit gained from assets owned, it is a measure of how well a company utilizes its resources. ROA as a metric indicator of a company’s profitability in terms of its total assets

#### FINANCIAL TECHNOLOGY

Fintech originally referred to the backend of financial institutions (Rubini 2018) Focus on the subject fintech started after the financial crises of 2008. The general started losing trust in incumbent institutions offering financial services and started innovating ways of providing the same financial services offered by the authorities at that time. In the year 2020 pandemic, fintech starts up experienced a big push in use and investments, due to their digital and cost-saving feature, This led to the birth of fintech unicorns in many countries such as the USA and Canada. According to KPMG, the total investment in fintech during the pandemic was USD105.9 billion across 2,891 deals. CCAF et al also recorded the volume of fintech transactions increasing by 13% and 11% in Q1-Q2 respectively during the pandemic. Dhaval Gorel said, “London and UK fintech sector are not immune to the pandemic, but they are sure weathering the storm.” Tim Levene also said, "effective application of technology and data by fintech challengers along with their inherent agility means they are well positioned to respond to the emerging structural opportunities.” Though some dark clouds hover around the thought of fintech such as future funding. Due to the Russia-Ukraine war, and the increase in the cost of living due to inflation. These uncertainties make the market unstable which draws caution on investment spending.

Fintech was first mentioned in the early 1990s by John Reeds the chairman of Citicorp in the context of a newly discovered “Smart Card Forum “ consortium (Puschmann 2017). Fintech reveals the fusion of finance and technology (Itay et al.). The term is given to companies that employ the use of technology in meeting the financial needs of clients and providing a solution to financial service problems. It can be defined as the use of technology in finance practices, in the essence of achieving efficiency, productivity and accuracy in financial services.

Fintech contributes to all areas of financial services, some of which are wealth management, asset management, risk management and insurance. There are four key areas of fintech: AI/ML, Blockchain, Cloud computing and Big data. Fintech has its subsectors that handle each financial service:

Table 2

|  |  |
| --- | --- |
| SUBSECTOR | DESCRIPTION |
| 1. PAYTECH | This is the use of technology in enhancing transaction and payment services. Examples of paytech companies are: Visa, Mastercard and PayPal |
| 1. WEALTHTECH | This involves the use of technology to facilitate investments and wealth management. This also involves the use of AI/ML (Robo advisor) and blockchain in the creation and management of wealth. Examples include Nutmeg and Moneyfarm. |
| 1. INSURETECH | The use of technology to enhance the insurance industry through automation, improvement in insurance policy and customer experience. This mainly involves the use of AL/ML Examples are: Lemonade, Wafox, Manypet and Fitsense. |
| 1. BANKTECH | Digital transformation in banking facilitates bank-driven strategies using technology such as API to create an end-to-end customer experience. Examples include Revolute, Monzo and Starling bank. |
| 1. LENDTECH | It is a subsector of fintech used to provide different forms of credit such as loans. This can be done through P2P and crowdfunding. Examples: Jumo, Upstart and Sofi. |
| 1. REGTECH | It is the use of technology to enhance regulatory and compliance processes in financial services. This mainly involves Cloud computing. Examples of regtech are: Arcada, 6clicks, Apex and Alessa |

## THEORETICAL REVIEW

Rama cont in his article on the empirical properties of stylized facts, made use of non and semi-parametric methods to test and describe statistical properties across financial assets and markets. He called these statistical properties that seemed consistent across the financial time series stylized facts and stated some statistical issues such as stationarity, ergodicity and finite sample properties of estimators. He concluded that these statistical properties he described were constraints based on the stochastic approach he applied and the failure of models able to replicate these statistical features. Though this was not the first-time empirical properties of stylized facts have been discussed. Fama (1965) when testing the validity of random walks, found evidence supporting the model absence of autocorrelation. Summers (1986) in his article “does the stock market rationally reflect fundamental values?” He implied that speculation does not determine rational valuation, past returns can't be used to predict future returns. Though Other researchers believed otherwise, such as Doan et al (1988) rejected the random walk hypothesis for weekly stock returns. Keim and Stambaugh (1986) also concluded that past stock prices contain information about the future stock price. Further research was done on stylized facts regarding asset return by Sewell (2011), who highlighted dependent and distributional empirical properties of financial times series. Yen et al (2020) tested for stylized facts on carbon emissions returns in china and found heavy tails, volatility clustering, and leverage effect but no long-range dependency properties using detrended fluctuation analysis in its investigation.

Researches have been done on the normality of distribution such as Adu et al (2015) using the multivariate joint test to test for normality in BRICS stock returns and made a conclusion in observing the presence of fat tails. Ling (2017) used an event clock instead of the traditional calendar clock and tested for normality in stock returns and did observe the returns to follow a normal distribution.

Volatility in asset returns is a topic invested in by many researchers. Tseng et al (2011) discovered a direct relationship between volatility clustering and slow decay in autocorrelation of absolute returns(nonlinear) using an index called the moving window method to further quantify the behaviour of clustering. Triacca (2014) observed the non-linear and asymmetrical behaviour of volatility clustering in both stock and foreign exchange markets using a univariate copula approach.

Clearly from the literature, some stylized facts are correlated, and debates about varying results using different methods for testing stylized facts on financial time series. This study seeks to add to the body of knowledge about stylized facts and test for their validity across different industries, using the various companies' time series stock data.

# CHAPTER THREE

## EMPIRICAL REVIEW

This study seeks to provide empirical findings on the behaviour of Heavy tails, Volatility clustering and Absence of autocorrelation using the share prices of Apple Inc, Mercedes Benz Inc, Walmart Inc and Goldman Sachs Group time series share price data from January 2010 to January 2022. This secondary data is collected from the Refinitiv database and yahoo finance is taken across several industries to test for the consistency of some generally accepted empirical properties of asset returns.

##### TEST FOR NORMALITY

The aim of this test is to observe if the given data follow normality in its distribution, using Jarque -Bera,Kolmogorov Smirnov and Shapiro Wilk tests. These three tests are done to be certain of decision-making in rejecting or accepting the null hypothesis.

H0 (null hypothesis) = It follows a normal distribution

H1 (alternate hypothesis) = Ho is not true

##### JACQUE-BERA TEST

Table 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| JACQUE-BERA TEST | | | | | |
| COMPANY | STANDARD DEVIATION | SKEWNESS | KURTOSIS | JACQUE-BERA STATS | P-VALUE |
| APPLE INC | 0.0177 | -0.3044 | 6.2150 | 4853.79 | 0.00 |
| GOLDMAN SACHS | 0.0183 | -0.3584 | 9.0424 | 10242.92 | 0.00 |
| MERCEDES BENZ | 0.0199 | -0.0205 | 14.1694 | 24997.56 | 0.00 |
| WALMART INC | 0.0119 | 0.1947 | 15.9108 | 31539.26 | 0.00 |

The Jarque-Bera test is used because of its reliability in analysing a large data set. The skewness and kurtosis of a normal distribution are 0 and 3 respectively, showing how symmetric the data is to the mean and its peakedness. This reveals the extreme values (Heavy tails) in the distribution. According to the normality test carried out, the skewness of the three companies is less than 0, displaying negative skewness and lack of symmetry with the mean, while Walmart's returns are positively skewed with high peakedness. The kurtosis value of the four companies is above 3, which is evidence of outliers. Due to the returns being leptokurtosis and asymmetric, the null hypothesis is rejected, and the alternate hypothesis is accepted.

##### Kolmogorov Smirnov and Shapiro Wilk Test

Table 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| COMPANY | KS STATS | P-VALUE | SW STATS | P-VALUE |
| APPLE INC | 0.47179978897262065 | 0.00 | 0.9380677342414856 | 0.00 |
| GOLDMAN SACHS | 0.4725172664989227 | 0.00 | 0.9206421375274658 | 0.00 |
| MERCEDES BENZ | 0.4719277778475117 | 0.00 | 0.9077590703964233 | 0.00 |
| WALMART INC | 0.4798830382203052 | 0.00 | 0.8716265559196472 | 0.00 |

Kolmogorov Smirnov and Shapiro Wilk test and their p values further justify the rejection of the null hypothesis and accept the alternate hypothesis.

##### NORMALITY PLOT

This study made use of the histogram and Q-Q plot in further analysis of asset return distributions. Using the Q-Q plot the return distribution deviates from both ends of the plot and exhibits non-normality in the distribution. This justifies the decision of rejecting the null hypothesis and accepting the alternate hypothesis.

##### VOLATILITY CLUSTERING

It was first defined by Maldbrot (1963) as when “large changes tend to be followed by large changes, of either sign, also when small changes tend to be followed by small changes”. This dependency creates an arbitrage, used in investment and trading strategies. The test carried out further proves the presence of volatility clustering in asset returns. The returns of the four companies show periods of low volatility clustering and high volatility clustering though Apple Inc exhibit more of a power law in its distribution (Inoua, 2016)

##### ABSENCE OF AUTOCORRELATION

This stylized fact further supports the market efficiency hypothesis, due to returns being non-correlated, which exhibits random walk. Using a lag of 50, with a significance level of 0.05, the test shows no sign of autocorrelation in any of the four company's returns. Absolute returns and squared returns decay slowly in this test as predicted by studies. Mercedes Benz absolute returns show more gap in autocorrelation compared to squared returns.

# CHAPTER FOUR

## CONCLUSION

This study was done to investigate the behaviour of asset returns, the role fintech plays in ascertaining asset behaviour, and the impact of fintech and asset returns on asset management. Asset returns seem to have a random walk property according to Fama (1965) and Summars (1986) while others such as Andrew et al (1988), Keim and Stambaugh (1986) disagree and proposed that past stock returns can be used to predict future stock returns. Adu et al (2015) did an investigation and found Heavy tails in the BRICS stock return distribution, Triacca (2014) also did a study and found the non-linear asymmetry behaviour of volatility clustering. This research was focused mainly on investigating heavy tails, volatility clustering and the absence of autocorrelation on share returns across industries. From the test carried out in this study, heavy tails, absence of autocorrelation and volatility clustering were found evident across the several financial time series that were investigated. With the help of AI/ML, long-time debates on asset returns have been settled. This is done by processing and analyzing large data, and testing hypotheses based on empirical and theoretical evidence. Through the use of fintech, more accurate reports in developing strategies in risk, asset and wealth management. It also enhances decision-making processes and automates repeated financial services tasks.

## REFERENCES

1. Pagan, A. (1996). The econometrics of financial markets. *Journal of Empirical Finance*.
2. Hirschman, Daniel. (2016) “Stylized Facts in the Social Sciences." Sociological Science 3.
3. R. Cont (2001) Empirical properties of asset returns: stylized facts and statistical issues, Quantitative Finance.
4. Chakraborti, Anirban & Toke, Ioane & Patriarca, Marco & Abergel, Frédéric. (2011). Econophysics review: I. Empirical facts. Quantitative Finance.
5. Tinbergen, J., Klaassen, L., Koyck, L. M., & Witteveen, H. J. (1959). Jan Tinbergen-Selected Papers.
6. Buchanan, M. (2012). It's a (stylized) fact! *Nature Physics*.
7. Rubini Agustín. (2018). Fintech in a flash: financial technology made easy (3rd ed.). De Gruyter.
8. Hill, J. (2018). *Fintech and the remaking of financial institutions*. Elsevier Science & Technology.
9. Malmsten, H., & TerÃ¤svirta, T. (2010). Stylized Facts of Financial Time Series and Three Popular Models of Volatility. *European Journal of Pure and Applied Mathematics*.
10. Fama, E. F. (1965). The Behavior of Stock-Market Prices. *The Journal of Business*.
11. Keim, D., and R. Stambaugh, 1986, “Predicting Returns in Stock and Bond Markets,” Journal of Financial Economics.
12. Doan, Tom & Lo, Andrew. (1988). Stock Market Prices do not Follow Random Walks: Evidence from a Simple Specification Test. Review of Financial Studies.
13. Yan, K., Zhang, W., & Shen, D. (2020). Stylized facts of the carbon emission market in China. *Physica A: Statistical Mechanics and Its Applications*.
14. Adu, G., Alagidede, P., & Karimu, A. (2015). Stock return distribution in the BRICS. *Review of Development Finance*.
15. Ling, X. (2017). Normality of stock returns with event time clocks. *Accounting & Finance*.
16. Tseng, J. J., & Li, S. P. (2011). Asset returns and volatility clustering in financial time series. *Physica A: Statistical Mechanics and Its Applications*.
17. Ning, C., Xu, D., & Wirjanto, T. S. (2015). Is volatility clustering of asset returns asymmetric? *Journal of Banking and Finance*.
18. Mandelbrot, B. (1963). The Variation of Certain Speculative Prices. *The Journal of Business*.
19. Puschmann, T. (2017). Fintech. Business &amp; Information Systems Engineering,
20. CCAF, World Bank and World Economic Forum (2020) The Global Covid-19 FinTech Market Rapid Assessment Report, University of Cambridge, World Bank Group and the World Economic Forum
21. Inoua, S. (2016). The Random Walk behind Volatility Clustering.
22. Sewell, M. (2011). Characterization of financial time series.
23. Asset Management - Overview, Importance and Benefits. (n.d.). Corporate Finance Institute; https://www.facebook.com/corporatefinanceinstitute.cfi/. Retrieved December 5, 2022, from https://corporatefinanceinstitute.com/resources/wealth-management/asset-management/
24. O’Connell, B. (2022, July 15). What Is Asset Management? – Forbes Advisor. Forbes Advisor; Forbes. https://www.forbes.com/advisor/investing/financial-advisor/what-is-asset-management/
25. Pulse of Fintech H2 2020 – Global insight - KPMG Global. (2021, February 23). KPMG; KPMG. https://home.kpmg/xx/en/home/insights/2021/02/pulse-of-fintech-h2-20-global.html#:~:text=Fintech%20investment%20dropped%20from%20US,acquisition%20of%20WorldPay%20by%20FIS.
26. Risk Management - Overview, Importance and Processes. (n.d.). Corporate Finance Institute; https://www.facebook.com/corporatefinanceinstitute.cfi/. Retrieved December 5, 2022, from https://corporatefinanceinstitute.com/resources/risk-management/risk-management/
27. What is asset management? | Lloyds Bank. (n.d.). Lloyds Bank - Personal Banking, Personal Finances & Bank Accounts. Retrieved December 5, 2022, from https://www.lloydsbank.com/wealth-management/what-is-asset-management.html#:~:text=Asset%20management%20is%20the%20day,a%20set%20of%20financial%20objectives
28. What is risk management? | IBM. (n.d.). IBM - United States. Retrieved December 5, 2022, from https://www.ibm.com/uk-en/topics/risk-management